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THE MASTERY OF COLOR

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THE MASTERY OF COLOR

A SIMPLE AND PERFECT COLOR SYSTEM,
BASED UPON THE SPECTRAL COLORS,
FOR EDUCATIONAL PURPOSES AND PRACTICAL USE
IN THE ARTS AND CRAFTS.

BY
CHARLES JULIUS JORGENSEN

VOLUME I.

DEMONSTRATED BY THE FUNDAMENTAL PIGMENTS,
APPLIED AND BLENDED IN THE AUTHOR'S STUDIO.

SMITHSONIAN

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by
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PREFACE.

The author, in his capacity as a professional colorist and decorator, covering a period of over forty years, found the conception of color by different individuals so vague and vacillating, that he recognized the need of a definite system for arranging colors in a practical form. This need became more apparent, when he found himself confronted with the problem of producing, arranging, combining and illustrating color suggestions, precisely and systematically, for use in his profession. Fully cognizant of these facts, the system here introduced was gradually originated and developed to fill this want.

In presenting this work to the students and workers in the field of color, the author is actuated merely by a recognition of the existing need of certain positive and approved methods. Its mission is to meet this need in a comprehensive manner, render aid of a practical character, and add to the better understanding of the phenomenon of color and the advancement of the fine arts.

Color is the festive garb of nature.

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THE MASTERY OF COLOR

INTRODUCTORY.

Though marvelous progress was made in the last century in all branches of science, industry and art, comparatively little was added to the world of color.

The art of mixing and combining colors is not confined to the province of genius, it is not a gift conferred upon the few; but it is the result of observation and study of the laws of nature, and therefore open to all intelligent people, except those whose organs of vision are defective.

No genius, however great, can properly mix colors without having familiarized himself with their nature, possibilities and limitations. Taste, talent and experience in color-mixing and combining, are the essentials in the achievement of

success. These essentials must receive their impetus by a conscientious study under a system that has been approved and found incontestably correct.

It is not sufficient to know HOW to mix colors, but it is absolutely necessary to understand WHY to mix them in a certain manner. The method of mixing a number of colors and tints, such as buff, drab, brown, terracotta, rose, olive, pink, slate, etc., similar to the various ready-mixed paints shown on sample cards, without any system whatever, soon proved to be insufficient, incomplete and impractical.

The system for color-classification and combination as presented in this work, deals exclusively with pigments, or bodies, and substances, which convey color sensation by reflection. Although technically imperfect, as compared with the pure physiological colors, pigments are the only means of mechanically producing colors and their combinations.

The primary colors, Yellow, Red and Blue, are taken as a standard for the Fundamental

Colors of this system, and are the means of defining the Theoretical Color Contents of every combination; they furnish the key for mixing and intermixing the pure fundamental colors in an intelligent, definite and systematic manner, thereby producing an almost endless number of tertiary, or broken colors. That tertiary colors must result by mixing the three primary colors in varied proportions is well known, but this has never been developed into a system, nor has it been adopted for practical use, for the reason that it is too difficult to mix three colors at once, regardless of the difficulty of obtaining pigments sufficiently pure to represent the primary colors.

The advantage derived by mixing but two colors at a time for producing every tertiary color, as established in this system, has reduced this difficulty to a minimum.

In order to show the accuracy of this system and its practical value, tables of Theoretical Color Contents have been embodied, representing in figures the theoretical contents of the

fundamental colors. These tables will assist the student materially in distinguishing the colors, and explain the difference between the various combinations.

The theories alone, mentioned in this work, are not expected to produce practical results but are referred to merely for explanation.

Since experience is of far greater assistance in the mixing of pigments than theory, plates showing the fundamental colors and their combinations, mixed, applied and blended by hand, are included in this work (Vol. II) as a practical demonstration and guide for the student, as well as for actual use by the professional colorist and artisan. The inexperienced eye may easily be trained to recognize and distinguish tones of color and their slightest variations by studying and experimenting under this system.

Color does not affect the vision of all individuals alike, irrespective of the fact that the causes of color sensation are always the same. It may be impossible to train the eye, which

is afflicted with color blindness; but it, nevertheless, remains true that the faculty of color conception, no matter how limited, can be developed and strengthened by systematic training.

The study and enjoyment of music has long become a privilege of the many by instruction in that art according to approved methods, while a methodical and uniform education in color has thus far been impossible for want of a proper system. The success achieved in the one, is also attainable in the other.

COLOR IMPRESSIONS.

Color is the first impression received from our surroundings, and is therefore the most important factor in art and industry. The new born child, as soon as he opens his eyes, receives color impressions, without being able to conceive them.

Conception of Color cannot be acquired without training and study; this faculty must be developed through the aid of proper educational methods, the same as any other undeveloped faculty of the mind or body.

The causes of Color Sensation have existed from the time when light first flashed through the universe and gave birth to the colors which nature reveals to our delight in the rainbow by refracting the sunlight in the falling rain.

It is an accepted theory that all color impressions are caused by the action of the light-waves on the retina of the eye, the different color impressions depending on the respective lengths of these light-waves. The eye is pas-

sive in receiving, and active in conveying color impression to the brain, and thereby producing color sensation.

SPECTRAL COLORS.

The colors of the sunlight, called the Spectral Colors, are Red, Orange, Yellow, Green, Blue and Violet, each blending into the other. The spectrum can be observed when a ray of sunlight is refracted by a glass prism on a white surface; the colors will appear in the same succession as before stated. The cut diamond, cut and beveled glass also show the spectral colors. Soap bubbles, and any oily substance on the surface of a pond, or other quiet body of water, will show the spectral colors in a faint measure.

Two theories regarding the spectral, or physiological colors, have been advanced; both divide them into Primaries and Secondaries. One theory holds that Yellow, Red and Blue are primary colors, and the secondaries are

produced by the blending of the primaries in pairs, where they touch in the spectrum in rotation as follows:

Red and Yellow	Yellow and Blue	Blue and Red
Orange,	Green,	Violet.

Another, and later theory, holds that the eye, by means of three separate sets of nerves, is susceptible to three primary color impressions, according to their respective wave-lengths, Red, Green and Violet-Blue. The remaining colors of the spectrum, classed as secondaries, are produced according to their intermediate wave-lengths, by stimulating two or all three sets of nerves at the same time.

Scientific works on physiological colors and colored light have exhaustively treated this subject; they give exact wave-lengths of the spectral colors, their degrees of luminosity, their relation to each other, as well as to white, gray and black. They also classify them in many different ways, give long lists of pleasing and displeasing combinations and other interesting

information, which is for the practical colorist frequently more misleading than useful. In fact none of those works on physiological colors have outlined any direction for classifying pigments in a comprehensive manner for practical use. The impossibility of systematizing pigments according to the theory accepting red, green and violet-blue as the primary colors, has undoubtedly retarded progress in this direction, as its fallacy with reference to the mixing of pigments is obvious.

COLOR CHARACTERISTICS.

In order that the terms used in this work for defining the characteristics of color may be more clearly understood, they are here enumerated and explained as follows:

SPECTRAL, or Physiological Colors, are the colors of the sunlight.

COLOR, signifies a Pigmental Color, whether elementary or combined.

ELEMENTARY COLORS, are the Primary Colors.

COMBINED COLORS, are the Secondary and Tertiary Colors.

PURE COLORS, are the Primaries and all the Secondaries.

The FUNDAMENTAL COLORS, are the Eighteen Colors of the Circle—the basis of this system.

BROKEN COLORS, are all Tertiary Colors.

NEUTRAL COLORS, are the primaries, and the three secondaries, each composed of two primaries adjusted half way between, neither color dominating.

HUE, applies to the Nature and Quality of color, such as red with a violet hue, or yellow with a greenish hue.

LUMINOSITY, expresses the Quantity of Light reflected by a color.

TONE is a tertiary color and indicates its Degree of Luminosity and Hue.

SHADE, designates a Color of Lowered Luminosity, caused by a reduction of light, i. e. by the introduction of black, or, by an admixture of a color of lower luminosity.

TINT, is a Color of Heightened Luminosity caused by increased light, or an addition of white.

COMPLEMENTARY COLORS, are the colors opposite each other in the Color Circle, one containing the primary or primaries, which the other lacks.

CHROMATIC COLORS, are all of the Fundamental Colors and their Combinations, except such mixture of them resulting in the formation of the Neutral Gray.

ACHROMATIC COLORS, are Black and White, singly and mixed with each other, and the Neutral Gray, because none of the fundamental colors are perceptible in them.

The POINT OF BALANCE between two colors, blended towards each other, is, where both vanish in a color most dissimilar to either one.

PIGMENTARY COLORS.

Pigments are not a source of color; they are substances, which, when spread over a body or surface, reflect the light-waves of their own inherent color and absorb all others. In art and industry most color impressions are produced by the use of pigments.

The ancients, having but few pigments at their disposal, made use of them, without mixing them with each other, by simply grouping them as the design demanded, divided by white or black outlines; sometimes producing quite pleasing and artistic combinations by these limited means. Thousands of years later the Moors produced the most wonderful effects by the use of yellow, red and blue in combination with a creamy white and black, the yellow being mostly represented by gold, and with the other pure colors was applied on the refined low relief ornamentation, adorning the architectural details of their beautifully constructed mosques

and public buildings. The Moorish decoration is the best illustration of the most artistic results obtained with pure primary colors.

In modern times conditions have materially changed. Our domestic architecture, carried out according to individual taste and ideas, can never assume a national character, and demands individual treatment in form and color; hence the necessity for a variety of colors suitable for all conditions and circumstances, in combination with other oftentimes arbitrary colors of stone, colored marble, tile, metalwork, hardwood, colored glass and other products of nature and art entering into the construction and furnishings of a modern home.

MODERN COLORS.

There are three classes of colors: Primary, Secondary and Tertiary Colors.

PRIMARY COLORS.

Colors which cannot be produced by combining two or more pigments, are Elementary or Primary Colors, namely:

Yellow, Red, Blue.

SECONDARY COLORS.

Colors which can be produced by the mixture of two primaries are Secondary Colors:

Yellow and Red	Red and Blue	Blue and Yellow
Orange,	Violet,	Green.

TERTIARY COLORS.

Colors produced by mixing three primaries directly, or by mixing the secondaries in pairs, are Tertiary Colors, because the three primaries compose them in scaled proportions. Formerly but Three Tertiary Colors, obtained by mixing these secondaries, were considered, viz:

Orange and Violet	Violet and Green	Green and Orange
Russet,	Olive,	Citrine.

The confining of the tertiary colors to these three probably was based upon the theory that the secondaries are produced by mixing two primaries, neither dominating in the combination, thus obtaining the three secondaries, and then mixing the secondaries in the same way, the possibility of forming other tertiaries seemed exhausted, notwithstanding the fact that tertiary combinations result as well by mixing a primary with a secondary containing the other two primaries, or two secondaries containing the three primaries in any proportion, as fully explained by the Tables of Theoretical Contents.

COLOR SYSTEM.

Numerous attempts have been made to establish colors and color systems by adding black pigment to the spectral and intermediate colors. Some Art and Technical Schools have accepted this method as a basis for instruction in color; and many artists consider black pigment the only medium to produce shades or broken colors, the theory being that black is a convenient agent in producing colors of lower luminosity by adding it in different proportions to a fixed number of pure colors. This theory, however, is not borne out in practice, in that it fails in color production, but merely results in color destruction. Most artists mix colors by traditional or individual methods in a mechanical way, without penetrating into the scientific cause of color harmony; but all great colorists, who reproduce nature in its full splendor, have certainly, unconsciously or by inspiration, adhered to the principle of this system, in which black is entirely avoided.

LUMINOSITY.

Since all colors are produced by light, they will appear most intense in the brightest light, and less intense and dull in subdued light. Orange, red and red-violet absorb more subdued light than blue, green and yellow, the latter three, therefore, appearing comparatively more luminous under these conditions.

Colors in subdued light lose some of their brilliancy, but they do not lose their character or hue. The subdued waves and the partly reflected light act upon them to a limited extent only, and leave a pleasing transparency, which, however, is always destroyed by darkening pure colors with black pigment. The more luminous the color is, the less surface will be required to balance color or colors of lesser luminosity. All authorities agree, that of the three primary colors, yellow is the most luminous, red next, and blue last. Opinions and experiments as to their respective degree of luminosity differ the same as the vision of different individuals.

As the mechanical engineer must contend with inertia and friction, so the colorist is impeded by the lesser purity and luminosity of the pigments substituting the physiological colors. All pigments are darker or less luminous than the corresponding colors of the spectrum, and some of them, such as the violets and the blue-violets, are much darker in tone.

No attempt has been made in fixing the pigments forming the fundamental colors, used as a basis for this system, to lighten the darker ones by the addition of white in order to make them correspond in luminosity with the spectral colors. These pigments of lower luminosity produce the darker tones generally obtained by an admixture of black.

BLACK AND WHITE.

Black and White are pigments, but not colors in the physiological sense. Black is the absence of all color, and white is its highest degree of luminosity. Black and white are the limits

of color. The mixture of black and white produces gray. This gray cannot always be accepted as a strictly neutral gray since most black pigments contain traces of chromatic color. It is well-known that the luminosity of any color can be expressed by an equivalent gray, consequently, yellow is equal to light gray, red to medium gray, and blue to dark gray, but this is of no practical value here, since the luminosity of the colors adjusts itself in a systematic manner.

NEUTRAL GRAY.

In contradistinction to the spectral colors, which, when united, constitute the white light, the corresponding pigments, when mixed in proportions necessary to destroy all identity of each individual color, will form Neutral Gray. In mixing the three primary colors in proper proportions the same gray is obtained. Any surface covered with this gray must reflect gray,

because all the chromatic colors are neutralized in it and are reflected together. This neutral gray can also be produced by mixing all the eighteen colors in the color circle in certain proportions, (see Plate 0, hereinafter described); however, this way is the most difficult, requiring great patience, utmost skill and long experience. It may look plausible that the neutral gray, resulting from the mixing of the three primary colors, will hold the balance in neutrality and luminosity between the three, but such is not the case, as it is more closely related to blue than to red or yellow; any attempt to increase its luminosity by adding red or yellow, will impair its neutrality.

Microscopic tests prove that this gray is a more agreeable and transparent color than a similar gray mixed of black and white, because the brilliant particles of the composing pure colors are plainly visible under the microscope, and will be found grouped alongside of each other, forming only a mechanical combination peculiar to all pigments.

As the proportion of each of the three primaries for producing this neutral gray must always be the same, provided the fundamental pigments are used, it is obvious that this gray can never be formed by mixing a primary and a secondary, unless the two primaries, composing such secondary, are represented in correct proportion to obtain the gray by simply adjusting the necessary quantity of the third primary; the result being mostly dependent upon the unchangeable proportion of the primaries, composing the secondary color, it is more or less unreliable. Endeavoring to mix this neutral gray by combining two secondaries containing the three primaries, is likewise difficult, as the proportion of the primaries in both secondaries is fixed and unchangeable.

The combinations by which a neutral gray is approximately produced are the following:

Yellow to Violet-Blue, . Plate 1 Combination No.5
Violet to Blue-Green, . Plate 10 Combination No.2
Blue-Violet to Green, . Plate 11 Combination No.3
Blue to Orange, ... Plate 13 Combination No.3

A small perforated piece of paper colored with the neutral gray, and mounted on Plate 21, is enclosed with the color plates, for locating the neutral gray in these combinations, and comparing the luminosity of the colors.

GRAY IN TERTIARIES.

A certain quantity of neutral gray is formed in every combination, containing the three primary colors, whether mixed separately, or mixed as secondaries. This neutral gray and the balance of the primary and secondary colors not consumed in its formation, combined, constitute the tone and hue of every tertiary color, ranging from the neutral gray to the pure fundamental colors.

COMPLEMENTARY COLORS.

Complementary physiological colors are considered to be such, that when combined revert to the white sunlight from which they originated. The human eye has the faculty of

developing involuntarily the image of the primary or secondary color insufficiently represented or entirely absent in its surroundings. Such imaginary color which the normal eye suggests is called the Complementary Color. The normal eye does not long endure the absence or preponderance of any one of the spectral colors. It soon becomes strained, and will endeavor to complement the wanting color as soon as the strain ceases, by reproducing this complementary color on a neutrally tinted surface or object.

If the eye is impressed exclusively by bright red in a room finished entirely in this color, it will involuntarily feel the absence of the other two primary colors, yellow and blue. After a presence of five or ten minutes in such a room, and upon suddenly entering an adjoining room finished entirely in white, and well lighted, the eye will immediately supplement, by its inherent faculty, the impression of light green, by forming the complementary color: yellow and blue blended to a tint of green, on the actually white surface; and the greater the contrast, the

quicker the eye will respond; the longer the strain lasts, the longer the phenomenon will be observable. Red and green seem to lead in complementary suggestion. Blue and orange, as well as yellow and violet are likewise complementary. The normal eye will even perceive strong complementary influences in combinations of tertiary colors. If the color, which the eye demands as complementary to a given color, is brought in juxtaposition to such given color, the purity of both will appear intensified. Red in contact with green seems to be redder and the green greener.

The careful study and consideration of this marvelous faculty of the eye to complement and enjoy the spectral colors in proper relation to each other, with reference to individual conception, is the secret of producing correct and pleasing combinations.

As it seems problematical to define exactly the complementary physiological colors, and as the same difficulty exists with the pigmentary colors, we assume that, for practical purposes,

pigmentary colors are complementary when one contains the primary or primaries which the other lacks. While pigments do not produce color, but merely reflect light-waves of their own color, and absorb all others when light is acting upon them, the test by covering one prismatic color with another to determine their complementaries, cannot be applied in regard to pigments. Optical and mechanical tests differ so widely, that they cannot be used as a practical pigmentary complementary standard.

Therefore, a positive and comprehensive basis must be adopted, and the colors opposite to each other in the color circle are here established as the Complementary Colors, because the one contains what the other lacks.

To combine pigments in a systematic manner, it is essential to arrange the colors, opposite to each other, according to their greatest difference in luminosity and hue, and it is thus demonstrated that all colors, claimed by the different theories to be complementary, are systematically represented in the resulting ninety

combinations. No practical color standard can ever be established by the adoption of the spectral colors and their physiological complementaries as a basis. It is frequently but erroneously assumed that any two complementary pigments, when mixed in proper proportion, must form the tertiary neutral gray; but experiments prove that this is not true; an examination of the respective combinations will verify this fact.

The pigmentary complementary colors are defined in three groups, each one showing a primary color and its complementary secondary, supplementing the other two primaries by the secondaries:

Yellow—Violet (red and blue)
Red—Green (yellow and blue)
Blue—Orange (yellow and red)

Unlike the physiological complementary colors, which combined, revert to white light, pigmentary complementary colors will, when mixed with each other, result in a number of tertiary colors, according to the proportion in which the primaries are represented.

FUNDAMENTAL COLORS.

The Fundamental Pigmentary Colors, used as the standard of this system, are based upon the spectral colors in the following succession: **Yellow, Orange, Red, Violet, Blue and Green.** By inserting two intermediate colors between each two, (including green and yellow,) uniformly scaled, the eighteen fundamental colors, which form the basis of this system are obtained.

The impossibility of finding six pigments which exactly represent the spectral colors in purity and neutrality, compels the colorist to combine the purest existing pigments as the only mechanical substitute. It is impossible to find even three pigments, which exactly represent the primary colors in purity and hue.

Following is the nomenclature of the fundamental colors, and a list of the pigments composing them. They are designated by their proper names, and have been most carefully se-

lected in regard to their mechanical adaptibility and permanency. Modern chemistry produces many colors which have but little body (covering quality, opaqueness) or permanency in resisting the action of light, atmosphere, or chemical influences, consequently the colorist must use the utmost care and discrimination in testing and selecting pigments.

The pigments used in establishing the Eighteen Fundamental Colors of this system are:

1. Yellow	Lemon Chrome Yellow and Medium Chrome Yellow.
2. Orange-Yellow	Medium Chrome Yellow and Light Chrome Orange.
3. Yellow-Orange	Light Chrome Orange and Medium Chrome Yellow.
4. Orange	Light Chrome Orange and Medium Chrome Yellow.
5. Red-Orange	Light Chrome Orange and Pale English Vermillion.
6. Orange-Red	Pale English Vermillion.

7.	Red	Carmine Vermillion and Turkey Red.
8.	Violet-Red	Carmine.
9.	Red-Violet	Carmine and Royal Purple.
10.	Violet	Carmine and Royal Purple.
11.	Blue-Violet	Royal Purple.
12.	Violet-Blue	Royal Purple and Ultramarine Blue.
13.	Blue	Deep Cobalt Blue and Ultramarine Blue.
14.	Green-Blue	Deep Milori Green and Deep Cobalt Blue.
15.	Blue-Green	Deep Milori Green and Medium Milori Green.
16.	Green	Medium Milori Green and Light Milori Green.
17.	Yellow-Green	Light Milori Green and Lemon Chrome Yellow.
18.	Green-Yellow	Lemon Chrome Yellow and Light Milori Green.

As shown, the three primaries, yellow, red and blue, were mixed of two pigments of similar color, but differing in hue. The lemon chrome yellow had a faint greenish hue, and the medium chrome yellow was a trifle orange in hue; hence, by mixing the two, the neutral, or fundamental yellow resulted. The carmine vermillion with an orange hue, and the Turkey red with its violet hue combined, produced a red nearer to the neutral fundamental red, than either of the two independently. The mixture of the deep cobalt blue, of a greenish hue, with the ultramarine blue of a violet hue, gave a better fundamental blue than either one separately. It is evident that this mixing of the primaries slightly impaired their individual purity by the formation of a minute quantity of gray, caused by the presence of a trace of the other two primaries, and could, therefore, theoretically, be considered tertiary colors. Nevertheless, the principle and usefulness of this system will not be affected in the least by this fact, as the actual colors in this work will clearly demonstrate.

The remaining fifteen fundamental colors, properly scaled, are all secondaries mixed of two pigments related in hue, or represented by one pigment of the proper color, as they contain but two of the primary colors and no trace of the third; consequently, they are theoretically and practically pure.

Further progress in the manufacture of colors may produce simple and pure pigments for each of these eighteen fundamental colors.

THE COLOR CIRCLE.

In order to arrange the fundamental colors in a way best adapted for practical use and study, the Color Circle, (Plate 0,) containing 18 sections, has been established, and divided into Groups I, II, and III, each group containing six sections, however fewer or more secondaries may be adopted to either reduce or extend the scope of this system, on the same principle.

As the succession of the three primary colors throughout this work is based upon their degree of luminosity, Yellow is assigned to Section No. 1, Red to Section No. 7, and Blue to Section No. 13.

The secondaries are assigned as follows: Orange to Section No. 4, Violet to Section No. 10, and Green to Section No. 16.

To the remaining twelve sections are assigned the twelve intermediate secondaries leading from each primary to the secondary on each side. Yellow, in Section No. 1, of the color circle, blends on the right to red, and on the left to blue.

The colors on the right half of the circle, as a class, are called warm, positive, or advancing colors, in contrast to those on the left half of the circle, which are known as cool, negative, or retiring colors, especially those in which blue predominates. Each of the three groups is headed by a primary color, as indicated by Nos. 1, 7, and 13, blended through five secondaries

to the next primary in rotation. The names and numbers of these fundamental colors are:

GROUP I, YELLOW TO RED.

Yellow, ... No. 1	Orange, ... No. 4
Orange-Yellow, No. 2	Red-Orange, . . No. 5
Yellow-Orange, No. 3	Orange-Red, . . No. 6

GROUP II, RED TO BLUE.

Red, ... No. 7	Violet, ... No. 10
Violet-Red, . . . No. 8	Blue-Violet, . . No. 11
Red-Violet, . . . No. 9	Violet-Blue, . . No. 12

GROUP III, BLUE TO YELLOW.

Blue, ... No. 13	Green, ... No. 16
Green-Blue, . . No. 14	Yellow-Green, No. 17
Blue-Green, . . No. 15	Green-Yellow, No. 18

Number 18 closes the Color Circle, and shows the perfectly scaled fundamental colors, which, when systematically mixed, two at a time in different proportions, produce every tertiary color. The colors opposite each other are naturally complementary, because one contains the primary, or primaries, which the other lacks, and when combined result in the most effective and exhaustive combinations. The

neutral gray described on page 28 shown in the center of the circle, is, in this case, obtained by actually intermixing the eighteen fundamental colors of the system as used in the Color Circle.

The circle is indispensable for the study and comparison of colors, and impressing them upon the mind, so that they are readily recognized by the student when seen anywhere and imagined when referred to by their respective names, the nomenclature being simple and logical. The system for intermixing the colors of the circle is explained in Table I, page 48.

THEORETICAL COLOR CONTENTS.

The nature and difference between the fundamental colors of this system are defined by the "theoretical" quantity of pure primary color which each contains.

Assuming the unit of theoretical contents of each primary color to be 6, in accordance with the six colors of each group, the decrease of one part of a primary in the combination of two, must result in the increase of one part in the other. This unit is adopted merely to define the theoretical contents and explain the process of mixing the colors according to this system. The weight, quantity, power, body and covering quality of these pigments are not considered.

Having fixed the number of colors in each group of the circle at six, it is assumed that the quantity of pure color in each of the primary colors is equal to the unit 6, viz:

Yellow = 6 parts yellow, 0 part red, 0 part blue, = 600.

Red = 0 part yellow, 6 parts red, 0 part blue, = 060.
Blue = 0 part yellow, 0 part red, 6 parts blue, = 006.

The Tables of Theoretical Color Contents on pages 48, 49, 50 and 51 are inserted for the use of those who wish to investigate the truths laid down in this treatise.

TABLE I, EXPLAINED.

In this table, the object of the Color Circle is further developed and explained. It shows the three groups of the circle. In column I the numbers of the eighteen fundamental colors in succession, and in column II the corresponding proper names of the fundamental colors are given. The letters, Y, R. B, over column III signify Yellow, Red and Blue, and the numbers in this column give the theoretical color contents of the fundamental colors. In columns IV, V, VI, VII and VIII the secondary colors of the next following group in their respective order are named, which are to be mixed succes-

sively with the colors of this group signified in columns I and II, thereby introducing the third primary: Blue.

In the first group the quantity of yellow is decreased one part in each of the five succeeding colors, and the red is increased in the same proportion; therefore, the numbers 3 3 0 stand for orange, as the color in which neither yellow nor red predominates. The 0, under B (blue), means that no blue is contained in this group.

In defining the theoretical primary color contents by numbers, the succession is Yellow, Red, Blue. Wherever 0 appears, it indicates the absence of the respective color; thus 6 0 0 means six parts of yellow, no part of red and no part of blue; consequently, it is pure yellow.

The second group, which contains no yellow is headed by red. Here the numbers 0 6 0 stand for pure red. The red is decreased one part in each of these five colors, and the blue is increased in the same proportion. Here 0 3 3

stands for violet, in which neither red nor blue predominates. The 0 means absence of yellow in this group.

The third group is headed by blue, 0 0 6, and the succeeding five colors are mixed by adding yellow in the same manner, thereby decreasing the blue in the same proportion. The 0 means absence of red in this group.

PREPONDERANCE OF COLOR.

By adding the theoretical contents of the six colors of each group, it is shown that the primary heading the group is predominating.

GROUP I.	Yellow	21 parts.
	Red	15 parts.
	Blue	0 parts.
GROUP II.	Red	21 parts.
	Blue	15 parts.
	Yellow	0 parts.
GROUP III.	Blue.	21 parts.
	Yellow	15 parts.
	Red	0 parts.

This completes the circle of the eighteen fundamental colors, which form the elements for the production of all tertiary colors.

TABLE OF COMBINATIONS,

Showing the Three Groups of the Color Circle, and the Theoretical Color Contents of the Eighteen Fundamental Colors and the Manner of Combining them.

GROUP I — YELLOW TO RED.

I	II	III (Y R B)	IV	V	VI	VII	VIII
1	Yellow	6 0 0	Viol. Red	Red Viol.	Violet	Blue Viol.	Viol. Blue
2	Or. Yellow	5 1 0	Viol. Red	Red Viol.	Violet	Blue Viol.	Viol. Blue
3	Yellow Or.	4 2 0	Viol. Red	Red Viol.	Violet	Blue Viol.	Viol. Blue
4	Orange	3 3 0	Viol. Red	Red Viol.	Violet	Blue Viol.	Viol. Blue
5	Red Or'ge	2 4 0	Viol. Red	Red Viol.	Violet	Blue Viol.	Viol. Blue
6	Or'ge Red	1 5 0	Viol. Red	Red Viol.	Violet	Blue Viol.	Viol. Blue

GROUP II — RED TO BLUE.

I	II	III (Y R B)	IV	V	VI	VII	VIII
7	Red	0 6 0	Green Blue	Blue Green	Green	Yel. Green	Green Yel.
8	Violet Red	0 5 1	Green Blue	Blue Green	Green	Yel. Green	Green Yel.
9	Red Violet	0 4 2	Green Blue	Blue Green	Green	Yel. Green	Green Yel.
10	Violet	0 3 3	Green Blue	Blue Green	Green	Yel. Green	Green Yel.
11	Blue Viol.	0 2 4	Green Blue	Blue Green	Green	Yel. Green	Green Yel.
12	Viol. Blue	0 1 5	Green Blue	Blue Green	Green	Yel. Green	Green Yel.

GROUP III — BLUE TO YELLOW.

I	II	III (Y R B)	IV	V	VI	VII	VIII
13	Blue	0 0 6	Or. Yellow	Yellow Or.	Orange	Red Or'ge	Or'ge Red
14	Green Blue	1 0 5	Or. Yellow	Yellow Or.	Orange	Red Or'ge	Or'ge Red
15	Blue Green	2 0 4	Or. Yellow	Yellow Or.	Orange	Red Or'ge	Or'ge Red
16	Green	3 0 3	Or. Yellow	Yellow Or.	Orange	Red Or'ge	Or'ge Red
17	Yel. Green	4 0 2	Or. Yellow	Yellow Or.	Orange	Red Or'ge	Or'ge Red
18	Green Yel.	5 0 1	Or. Yellow	Yellow Or.	Orange	Red Or'ge	Or'ge Red

COMBINATION

of Colors of Group I with Colors of Group II
and their Theoretical Color Contents.

	Y R B Y R B	
Yellow	6 0 0 . 0 5 1	Violet-Red
Yellow	6 0 0 . 0 4 2	Red-Violet
Yellow	6 0 0 . 0 3 3	Violet
Yellow	6 0 0 . 0 2 4	Blue-Violet
Yellow	6 0 0 . 0 1 5	Violet-Blue
Orange-Yellow	5 1 0 . 0 5 1	Violet-Red
Orange-Yellow	5 1 0 . 0 4 2	Red-Violet
Orange-Yellow	5 1 0 . 0 3 3	Violet
Orange-Yellow	5 1 0 . 0 2 4	Blue-Violet
Orange-Yellow	5 1 0 . 0 1 5	Violet-Blue
Yellow-Orange	4 2 0 . 0 5 1	Violet-Red
Yellow-Orange	4 2 0 . 0 4 2	Red-Violet
Yellow-Orange	4 2 0 . 0 3 3	Violet
Yellow-Orange	4 2 0 . 0 2 4	Blue-Violet
Yellow-Orange	4 2 0 . 0 1 5	Violet-Blue
Orange	3 3 0 . 0 5 1	Violet-Red
Orange	3 3 0 . 0 4 2	Red-Violet
Orange	3 3 0 . 0 3 3	Violet
Orange	3 3 0 . 0 2 4	Blue-Violet
Orange	3 3 0 . 0 1 5	Violet-Blue
Red-Orange . .	2 4 0 . 0 5 1	Violet-Red
Red-Orange . .	2 4 0 . 0 4 2	Red-Violet
Red-Orange . .	2 4 0 . 0 3 3	Violet
Red-Orange . .	2 4 0 . 0 2 4	Blue-Violet
Red-Orange . .	2 4 0 . 0 1 5	Violet-Blue
Orange-Red . .	1 5 0 . 0 5 1	Violet-Red
Orange-Red . .	1 5 0 . 0 4 2	Red-Violet
Orange-Red . .	1 5 0 . 0 3 3	Violet
Orange-Red . .	1 5 0 . 0 2 4	Blue-Violet
Orange-Red . .	1 5 0 . 0 1 5	Violet-Blue

COMBINATION

of Colors of Group II with Colors of Group III
and their Theoretical Color Contents.

	Y R B Y R B	
Red	0 6 0 . 1 0 5	Green-Blue
Red	0 6 0 . 2 0 4	Blue-Green
Red	0 6 0 . 3 0 3	Green
Red	0 6 0 . 4 0 2	Yellow-Green
Red	0 6 0 . 5 0 1	Green-Yellow
Violet-Red . .	0 5 1 . 1 0 5	Green-Blue
Violet-Red . .	0 5 1 . 2 0 4	Blue-Green
Violet-Red . .	0 5 1 . 3 0 3	Green
Violet-Red . .	0 5 1 . 4 0 2	Yellow-Green
Violet-Red . .	0 5 1 . 5 0 1	Green-Yellow
Red-Violet . .	0 4 2 . 1 0 5	Green-Blue
Red-Violet . .	0 4 2 . 2 0 4	Blue-Green
Red-Violet . .	0 4 2 . 3 0 3	Green
Red-Violet . .	0 4 2 . 4 0 2	Yellow-Green
Red-Violet . .	0 4 2 . 5 0 1	Green-Yellow
Violet	0 3 3 . 1 0 5	Green-Blue
Violet	0 3 3 . 2 0 4	Blue-Green
Violet	0 3 3 . 3 0 3	Green
Violet	0 3 3 . 4 0 2	Yellow-Green
Violet	0 3 3 . 5 0 1	Green-Yellow
Blue-Violet . .	0 2 4 . 1 0 5	Green-Blue
Blue-Violet . .	0 2 4 . 2 0 4	Blue-Green
Blue-Violet . .	0 2 4 . 3 0 3	Green
Blue-Violet . .	0 2 4 . 4 0 2	Yellow-Green
Blue-Violet . .	0 2 4 . 5 0 1	Green-Yellow
Violet-Blue . .	0 1 5 . 1 0 5	Green-Blue
Violet-Blue . .	0 1 5 . 2 0 4	Blue-Green
Violet-Blue . .	0 1 5 . 3 0 3	Green
Violet-Blue . .	0 1 5 . 4 0 2	Yellow-Green
Violet-Blue . .	0 1 5 . 5 0 1	Green-Yellow

COMBINATION

of Colors of Group III with Colors of Group I
and their Theoretical Color Contents.

	Y R B Y R B	
Blue	0 0 6 . 5 1 0	Orange-Yellow
Blue	0 0 6 . 4 2 0	Yellow-Orange
Blue	0 0 6 . 3 3 0	Orange
Blue	0 0 6 . 2 4 0	Red-Orange
Blue	0 0 6 . 1 5 0	Orange-Red
Green-Blue . .	1 0 5 . 5 1 0	Orange-Yellow
Green-Blue . .	1 0 5 . 4 2 0	Yellow-Orange
Green-Blue . .	1 0 5 . 3 3 0	Orange
Green-Blue . .	1 0 5 . 2 4 0	Red-Orange
Green-Blue . .	1 0 5 . 1 5 0	Orange-Red
Blue-Green . .	2 0 4 . 5 1 0	Orange-Yellow
Blue-Green . .	2 0 4 . 4 2 0	Yellow-Orange
Blue-Green . .	2 0 4 . 3 3 0	Orange
Blue-Green . .	2 0 4 . 2 4 0	Red-Orange
Blue-Green . .	2 0 4 . 1 5 0	Orange-Red
Green	3 0 3 . 5 1 0	Orange-Yellow
Green	3 0 3 . 4 2 0	Yellow-Orange
Green	3 0 3 . 3 3 0	Orange
Green	3 0 3 . 2 4 0	Red-Orange
Green	3 0 3 . 1 5 0	Orange-Red
Yellow-Green .	4 0 2 . 5 1 0	Orange-Yellow
Yellow-Green .	4 0 2 . 4 2 0	Yellow-Orange
Yellow-Green .	4 0 2 . 3 3 0	Orange
Yellow-Green .	4 0 2 . 2 4 0	Red-Orange
Yellow-Green .	4 0 2 . 1 5 0	Orange-Red
Green-Yellow .	5 0 1 . 5 1 0	Orange-Yellow
Green-Yellow .	5 0 1 . 4 2 0	Yellow-Orange
Green-Yellow .	5 0 1 . 3 3 0	Orange
Green-Yellow .	5 0 1 . 2 4 0	Red-Orange
Green-Yellow .	5 0 1 . 1 5 0	Orange-Red

TERTIARY COLOR COMBINATIONS.

See Table I.

As but two primaries are represented in each group of the circle, the production of tertiary colors would never be possible by intermixing the colors of one group, as the third primary wanted for tertiary combinations is not contained therein. It is therefore necessary to combine with colors of other groups, containing the third primary; and thereby make the most exhaustive use of the seemingly limited possibilities which pigments offer for producing positive tones. The novice may presume that the proportions for mixing colors might be ascertained by weight or measure; this, however, is neither practical nor possible, as luminosity and body (covering quality) differ in all pigments. Physiological experiments in color mixing are of no avail as they have no bearing on the mixing of the pigments.

Studying the colors and their combinations produced by this system will soon develop

the great sensitivity of the eye to such an extent, that the slightest difference in tone and hue between the many colors is readily distinguished, while the difference could not be ascertained in any other way. Individual faculties, such as a trained eye, judgment and good taste, can never be substituted by mechanical means. As pigments have more or less intensity, body or covering quality, two colors cannot be mixed in equal quantities to produce a color, which in luminosity and hue lies just between the two; it must be the eye which defines and judges colors and their variations. The simplicity of mixing, or reproducing any desired tone by using but two fundamental colors at a time, is the great advantage of this system.

THE NINETY COMBINATIONS.

The ninety accurately scaled color combinations resulting from the systematic mixing of the fundamental colors in pairs, are produced as demonstrated in Table I.

In order to obtain the tertiary colors as before mentioned, it is necessary to mix the colors of one group containing two primaries, with the colors of the next group which contain the third primary in connection with one of the others, viz.: Group I, yellow and red; Group II, red and blue; Group III, blue and yellow. This is accomplished in the following manner:

Starting with No. 1, yellow, of Group I, containing the combination from yellow to red, the third primary, blue, not contained therein, is first found in Group II, No. 8, the "violet-red," which contains no part of yellow, five parts of red and one part of blue $= \frac{Y\ R\ B}{0\ 5\ 1}$. The yellow is then mixed with the violet-red $= \frac{Y\ R\ B \text{ to } Y\ R\ B}{6\ 0\ 0 \quad 0\ 5\ 1}$ gradually blending from one to the other. The

numbers show the theoretical contents of the two colors in the combination as carried out in Table II, defining the theoretical contents of the combination of the colors of Group I, as mixed with the colors of Group II in succession. The yellow is then blended with colors Nos. 9, 10, 11 and 12 of Group II, in which blue is increased by one theoretical part in each succeeding color, and the red is decreased in the same proportion. See Table II and Plate 1.

The next color, orange-yellow, containing five parts of yellow, one part of red and no part of blue, is then blended with colors Nos. 8, 9, 10, 11 and 12 of Group II. See Table II and Plate 2.

Yellow-orange, containing four parts of yellow, two parts of red and no part of blue, is then blended with the same colors, Nos. 8, 9, 10, 11 and 12 of Group II. See Table II and Plate 3.

The orange, containing three parts of yellow, three parts of red and no part of blue, is

then blended with the same colors, Nos. 8, 9, 10, 11 and 12 of Group II. See Table II and Plate 4.

The next, red-orange, containing two parts of yellow, four parts of red and no part of blue, is then blended with colors, Nos. 8, 9, 10, 11 and 12 of Group II. See Table II and Plate 5.

The last of the first group is orange-red, which is also blended with the colors Nos. 8, 9, 10, 11 and 12 of Group II. See Table II and Plate 6. This ends the possible combinations of the colors of Group I with the colors of Group II.

While the red is increasing by one theoretical part in the colors of Group I, as shown in Column III, Table I, the blue is increasing by one theoretical part in each of the colors of the second group, and the red is decreasing in the same proportion. In summing up the combined theoretical contents of the colors of Group I, blended with the colors of Group II (see Table II), it is shown that the red predominates in this group.

Red is represented by . . 165 parts.
Yellow is represented by 105 parts.
Blue is represented by . . 90 parts.

Group II, in which red is mixed with blue, is then blended with the colors of Group III (see Table I), containing the first primary, yellow, not contained in Group II, i. e., yellow mixed with blue. Red, No. 7, is then blended with green-blue, No. 14, containing one part of yellow and five parts of blue, and is then blended in the same manner with colors Nos. 15, 16, 17 and 18 of Group III; thereby introducing the yellow, and increasing it one theoretical part in each succeeding color, the blue decreasing in the same proportion. See Table III, Plates 7 to 12 inclusive.

Next, violet-red is blended with the colors Nos. 14, 15, 16, 17 and 18 of Group III.

Next, red-violet is blended with the above colors.

Next, violet is blended with the same colors as before.

Blue-violet and violet-blue would then complete the blending of the colors of Group II

with the colors Nos. 14, 15, 16, 17 and 18 of Group III.

In adding the theoretical parts contained in the colors of these two groups, it is shown that blue is the predominating color in this combination.

Blue is represented by . 165 parts.
Red is represented by . 105 parts.
Yellow is represented by 90 parts. See Table III.

The colors of Group III, Nos. 13, 14, 15, 16, 17 and 18, containing blue and yellow, are blended with the colors Nos. 2, 3, 4, 5 and 6 of Group I, containing the second primary, red, mixed with yellow, in the same rotation and manner as the other groups.

The combination of these two groups shows a predominance of yellow.

Yellow is represented by 165 parts.
Blue is represented by . 105 parts.
Red is represented by . . 90 parts. See Table IV.

These ninety combinations cover all primary, secondary and tertiary colors found in nature and art, and in their blending and arrangement form a perfect and endless chain of

color. The comparison of these combinations with their corresponding colors in nature will materially aid the student to a more thorough conception of the realm of color, but as these comparisons are easily made, no further suggestions in this direction are deemed necessary.

THEORETICAL AND PRACTICAL PROOF.

The normal eye will receive satisfactory proof of the accuracy of this system by closely studying and comparing the combinations. The theoretical contents exhibited in Tables II, III and IV are likewise conclusive, and every color and combination in this system can be correctly and definitely designated by their figures of theoretical contents, without naming the colors.

The mathematical proof, establishing the difference of all the ninety combinations by comparison, is made in the following manner: The parallelograms on pages 60, 61 and 62 are

vertically divided into ten equal spaces; the horizontal division consists of six spaces. These six spaces are intended to be analogous to the adopted number of theoretical color contents entering into each combination from left and right, and defined by diagonal lines.

COMBINATION No. 3, PLATE 1.

Yellow to Violet, 600—033.

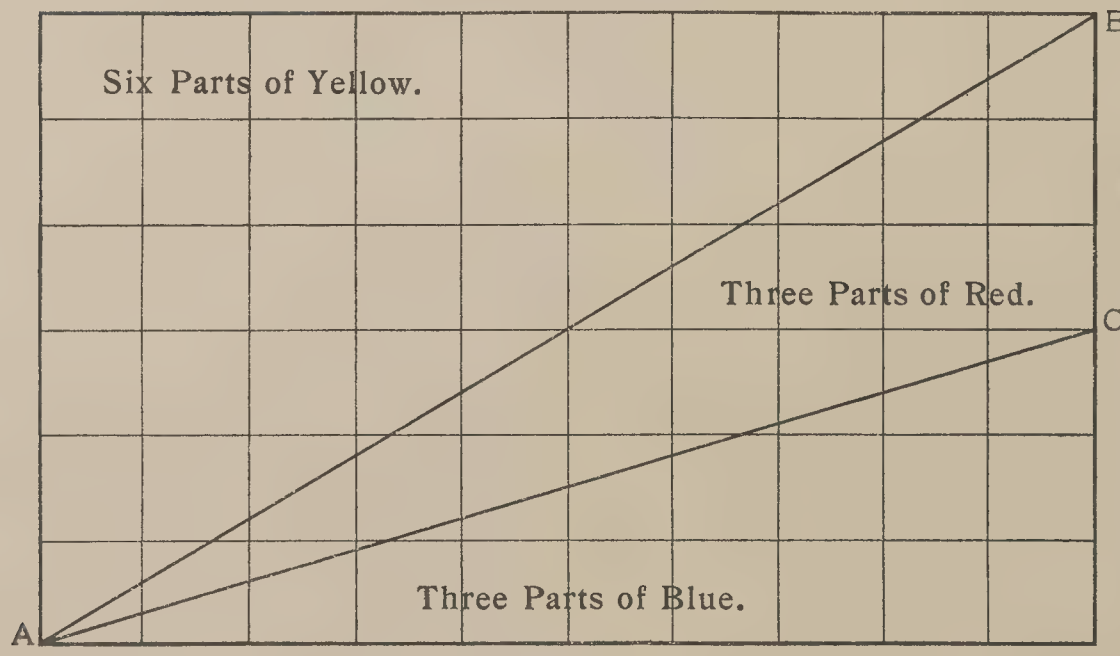

Figure 1.

This example shows combination No. 3, Plate 1, yellow to violet, in which six parts of

yellow are blended from the left, and three parts of red, and three parts of blue from the right. A—B dividing the yellow from the red, and A—C the red from the blue.

COMBINATION No. 3, PLATE 2.

Orange-Yellow to Violet, 5 1 0—0 3 3.

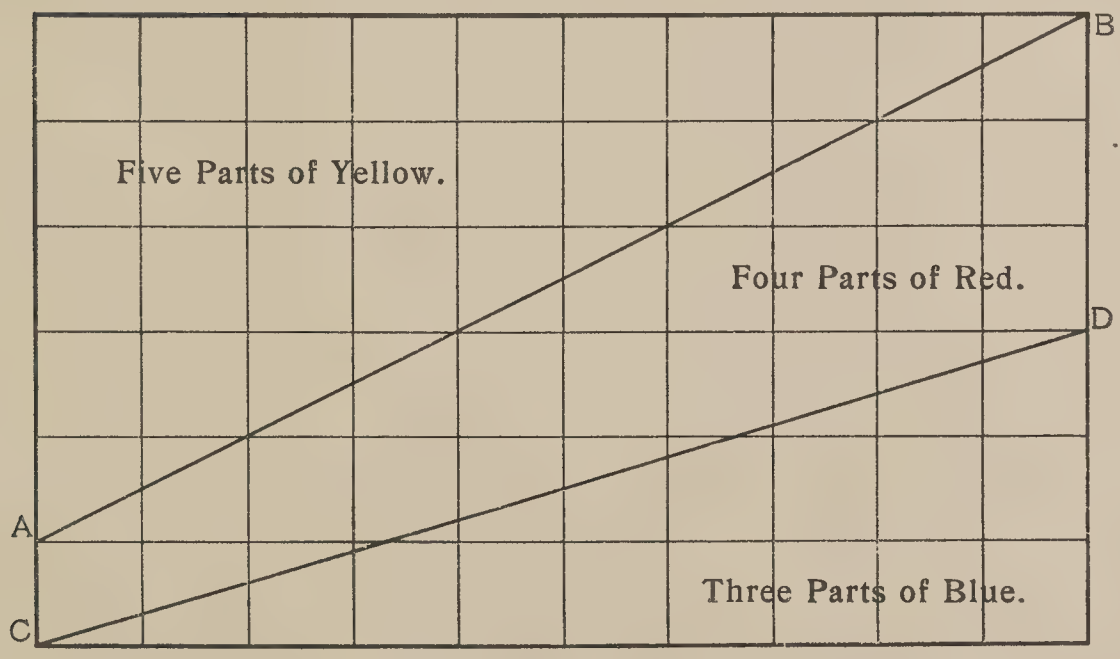

Figure 2.

The object of selecting this combination for the second example is to show the slightest difference in color, the theoretical contents varying only one part from Figure 1, the yellow

having decreased one part and the red increased in the same proportion; hence the difference in the diagonal lines. Here are five parts of yellow divided by A—B from one part of red from the left, and three parts of red from the right, which in turn are divided by C—D from the three parts of blue from the right, and form an irregular quadrangle, A, B, D, C.

COMBINATION No. 1, PLATE 12.

Violet-Blue to Green-Blue, 0 1 5 — 1 0 5.

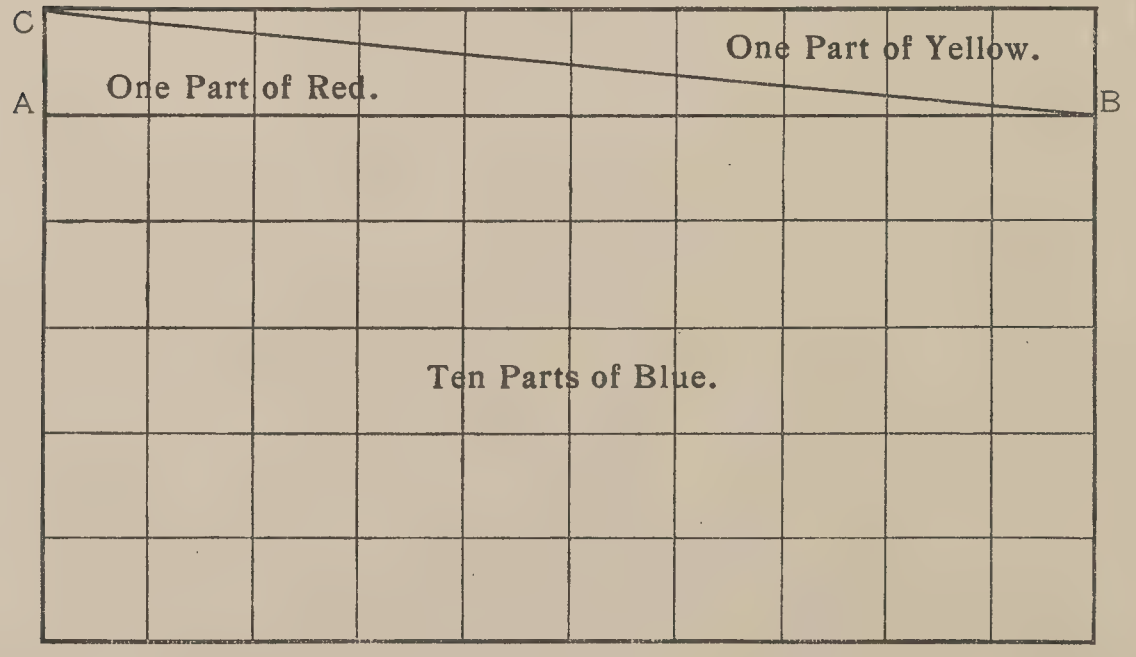

Figure 3.

Fig. 3. This combination has been selected as it shows the greatest possible preponderance of a primary color under this system, i. e., Combination No. 1, Plate 12, Violet-Blue to Green-Blue, 0 1 5--1 0 5. It contains five parts of blue and one part of red from the left, and five parts of blue and one part of yellow from the right. The horizonal line A—B divides the ten parts of blue (five from each side) from the one part of red from the left, which again is divided from the one part yellow from the right by C—B. The vertical lines are intended to facilitate comparison at the intersecting points, in order to prove that the proportions of the primary contents differ at every point in each, as well as in all of the ninety combinations, which when carried out in this manner, will prove mathematically the correctness of this system.

TONES AND TINTS.

By mixing any color in the ninety combinations with White the luminosity of the former is increased, and its intensity of tone is decreased at the same time. A multitude of tints can be produced in this way, the number depending in each case upon the difference in luminosity between the color to be combined and the white, and also on the capability of the eye to distinguish the tints.

Plate 19 shows eighteen intermediate distinct and separated colors of Combination No. 1, Plate 14, Green-Blue to Orange-Yellow, as an illustration of how the intermediate colors of every one of the ninety combinations can be made in the same manner; however the number of such colors depends entirely on the difference in luminosity and hue between the two colors forming the combination.

Plate 20 shows Color No. 6 of the combination of green-blue to orange-yellow on Plate

19, blended to white through eighteen perfectly scaled tints. Averaging the intermediate colors in each of the ninety combinations at fifteen, and the tints of each color in each combination at the same number, over twenty thousand colors and tints will result, of which no two can ever be alike.

USE OF THE COLOR PLATES.

The ninety combinations, embracing every conceivable color, are of the greatest value for the introduction into the world of color, and furnish the means of defining and establishing all tones of color, and their combinations. It is no longer necessary to describe imaginary colors, as the actual colors can be pointed out and their fitness for the purpose is easily determined.

An addition of white to the colors, as before stated, will produce any and all tints desired. It might be assumed, that the adding of black

to these colors in the same manner would result in forming their shades, but as explained before on page 27, this is neither necessary nor desirable. If darker colors are required it is advisable to use the colors ground in oil, which will darken them considerably without impairing their character.

The mats, on which the colors, showing the ninety combinations, are mounted, are almost neutral gray, a background best adapted for this purpose, as it neither affects their luminosity nor hue. A background of black would seemingly increase the luminosity of the colors and a white background would lower it. The plates and combinations are numbered, and the colors defined by their fundamental names and theoretical contents for easy reference.

In order to get the best view of all combinations for comparison at the same time, place them on a table, or fasten them to a wall in three vertical rows, heading the first with Plate No. 1, the second with Plate No. 7, and the

third with Plate No. 13, thus conforming with the arrangement of the groups of the color circle.

This arrangement will show, on the three top plates, the combination of each of the three primary colors, blended with the complementary secondary color directly opposite, and the two colors adjoining the secondary on each side of it in the color circle. In the first row on Plate 1, on the left of the five combinations is Yellow, blended on the right with violet-red, red-violet, violet, blue-violet and violet-blue in succession; these colors are the same on the right on each plate in this group, while the yellow on the left is decreasing on each succeeding plate by one theoretical part, and the red is increasing in the same proportion until in Plate No. 6 it ends in red-orange. This group contains a preponderance of red. (See page 57 and Table II.)

The second group is headed with Red on the left in the five combinations on Plate No. 7, blended in the same manner with green-blue,

blue-green, green, yellow-green and green-yellow of the color circle. These five colors appear on the right side of each plate in this group, while on the left the colors are the same on each plate, but are scaled from red to violet-blue, the red decreasing and the blue increasing by one theoretical part on each succeeding plate until it ends in the violet-blue, Plate 12. This group has a preponderance of blue. (See page 58 and Table III.)

The third group is headed on the left by Blue on Plate No. 13, also blended in the same manner with orange-yellow, yellow-orange, orange, red-orange and orange-red of the color circle. As in the other groups the colors on the right repeat on every plate in this group, while on the left the colors are the same on each plate, scaled from blue to green-yellow on each succeeding plate, the blue decreasing and the yellow increasing by one theoretical part, until it ends in the green-yellow on Plate No. 18. In this group the yellow predominates. (See page 58 and Table IV.)

In passing the eye over the combinations, the fundamental colors appear in rotation on the left of the plates from No. 1 to No. 18. The right side of Group I shows the intermediate colors leading from red to blue on each plate; on the right side of Group II the five intermediate colors composed of blue and yellow appear on each plate, and on the right side of Group III the five intermediate colors composed of yellow and red repeat on each plate.

POINT OF BALANCE.

It is very interesting to observe, by blending two colors, especially those opposite, or nearly opposite each other in the color circle, how both become active and endeavor to uphold their individuality to the full extent of their respective powers, until they balance each other in a color which unites the characteristics of both, modified by the neutral gray forming in every tertiary combination.

Theoretically, the point of balance should be in the center of each combination, and wher-

ever this varies, it is caused by the mechanical difficulty of blending all combinations uniformly.

The most effective and exhaustive combinations result, as before stated, by blending two colors which differ most in luminosity and hue. Among them, for instance, are:

Yellow and Violet-Blue	Plate 1
Yellow and Blue-Violet	Plate 1
Red-Violet and Green-Yellow . . .	Plate 9

The combinations showing the smallest possibilities, because their theoretical contents being ten parts of one primary and but one part of each of the others, are:

Orange-Red and Violet-Red . . .	Plate 6
Violet-Blue and Green-Blue . . .	Plate 12
Green-Yellow and Orange-Yellow	Plate 18

(Compare theoretical contents on Tables II III and IV.)

THE PERFORATED MAT.

The perforated mat, when placed over a combination, will show ten distinct colors, even where the smallest difference exists, the per-

forations being numbered to facilitate the designation of such colors. In moving the mat a quarter of an inch to one side, the intermediate colors will appear. Even if the eye should be unable to distinguish them plainly in this small quantity, the difference will be more noticeable by comparing larger surfaces covered with these colors. The ability to distinctly perceive the difference in tone and hue in each of the ninety combinations of the fundamental colors, and in relation to each other, proves a well developed vision beyond doubt.

COLOR-BLINDNESS.

Color-blindness has been found an optic affliction. It consists in partial or total inability to conceive and distinguish certain spectral colors. The colors in the circle can be used for a test, especially the red and green. Failure to discover any difference in tone and hue between the colors opposite each other is a positive proof of color-blindness.

HARMONY OF COLOR.

The laws of Color Harmony are not the work of man or fashion, and should never be violated nor ignored. Harmony of color is a combination of colors agreeable and satisfactory to the normal eye. Harmony depends, however, upon so many other influences and conditions, aside from the peculiarities of the colors themselves, that no special positive rules of harmony can ever be established; and the only way for the colorist to master the problem is to consider surroundings, circumstances and purpose, use his experience, skill and good judgment, with due reference to the characteristics of the individual for whom the color is intended.

The simple principle of harmony is always to show a suggestion of the wanting primary in every combination of colors. This is done by introducing this primary color incidentally in an ornament, or by simply mixing it with

some other color of the combination. The complementary colors, as shown in the color circle, form the basis of all color harmony.

In order to lend repose and character to a combination, one color must dominate in power or quantity.

The addition of white to a color will produce a tint which will match in hue, but differ in tone. This, however, constitutes no harmony, as no complementary color is introduced. To produce a harmony it is necessary to select a color nearer to either one or the other pure colors of the same combination and adjust its tone by adding white. The old method of professionals to blend two contrasting colors by adding from one to the other and vice versa, until they appear satisfactory, is the practical solution of harmonizing colors. The student will soon be able to acquire this practice by observing and experimenting under this system; it will help him to define the colors, teach him HOW to mix them, and WHY to mix them in the manner herein established.

HARMONY IN THE COMBINATIONS.

By separating the colors of the combinations with the perforated mat, it will be found, that any two colors in the same combination will harmonize with each other, because every combination represents all three primaries, forming a harmony in itself and excluding all possibilities of creating anything but harmony.

Either of the two fundamental colors forming such combination will harmonize equally well with the color in their point of balance. The colors on one side thereof will form a softer harmony, while a combination of the colors on each side of the point of balance will form a more contrasting or complementary harmony, which will increase or decrease according to the distance that these colors are located from the point of balance.

The colors at or near the point of balance are the most suitable and agreeable as a back-

ground on surfaces or objects in art and industry. They are restful to the eye, and will enhance the beauty and charm of any juxtaposed brighter color. In interior decoration, in connection with lustrous hardwood, rich floor coverings, valuable pictures and works of art, tertiary colors properly combined are of the greatest importance for creating harmony, and will always lend to an interior that air of refinement and chaste elegance which appeals to the educated eye and mind.

The following shortly illustrates how to use the combinations in planning color schemes for interior decoration.

Considering the existing conditions and restrictions in a room for which a color scheme is to be planned, the woodwork usually is the most important factor, as it comes in contact with the ceiling, wall and floor. Assuming the woodwork to be Satinwood, which is of a yellowish color, take the nearest color to it in the color circle for one of the colors of the scheme, which color is the fundamental yellow, No. 1,

and, in order to take advantage of the greatest possibilities the opposite color in the circle, violet, is taken as the second color. It will be found that the combination of these two colors is Combination No. 3, Plate 1, Yellow to Violet. Separating the colors of this combination by the perforated mat, color No. 7 lightened two tones with white, furnishes an agreeable color for the walls, and color No. 5 for the frieze, cornice and ceiling. Containing more yellow it will counteract the cooler indirect light prevailing in the upper portion of every room, deriving light through windows on the side. This color can be lightened sufficiently by an addition of white to appear two to three tones lighter than the walls.

The color suggestions for draperies, furniture coverings and carpets will be found in colors Nos. 7, 8, 9 and 10, enlivened with the lighter and more yellow colors of the same combination. These colors can also be introduced on ceilings and walls in surface ornamentation and in embroidery on draperies and furniture;

gold ornamentation in embroidery would increase the effect of this combination. No discord can ever occur by making color-schemes in this manner.

The introduction of some incidental colors through pictures, objects of art, bric-a-brac, etc., will be found to be easier and much more effective in such systematic color combination than in any accidental color-scheme.

Advanced decorators are well aware that materials in the softer colors, as selected for the above combinations are difficult to find among stock fabrics, etc., and are forced to resort to having suitable material made or dyed for such purposes. The facility with which the desired color can be established and conveyed by an actual color sample according to this system will be of the greatest advantage to the professional and amateur alike; even laymen will be enabled to express their preference and taste in a precise manner.

In planning effective color-schemes it is essential always to blend the color requiring con-

sideration with the color directly opposite or one of the two adjoining colors on each side and nearly opposite in the color circle, all of these five containing the third primary in scaled proportions.

The same principle applies to the selection of dress goods, where colors nearer to the point of balance in suitable combinations will have a pleasing influence on the complexion, and are also well adapted for tasty combinations with other soft or even brighter colors if desired. To use the fundamental colors in their purity, without combining them with softer broken colors, will never satisfy the educated eye.

The beneficial or detrimental effect of a color on the complexion can also be regulated according to the color circle. A rosy complexion can be heightened by the complementary color. Rose, being a tint of red, will be complemented extremely by a tint of the opposite green (Combination No. 3, Plate 7, red to green); charmingly by a tint of the color be-

tween the green and the point of balance; fittingly by a tint of the color in the point of balance; and poorly by a tint of color near the red.

COLOR MIXING.

The mixing of these combinations is exceedingly interesting and instructive. In order to exhaust the possibilities of a combination, the color in the point of balance should be mixed first, and next the two colors between this and the colors on each side, and so on until the difference becomes too small to be distinguished.

In order to produce tints, the same method of first mixing a balancing color between the white and the color selected should be followed. The possibilities in creating the scaled tints of every one of the colors in the ninety combinations, as described on page 64, and illustrated on Plate 20, seem almost inexhaustible.

The advantages derived from experimenting with the fundamental colors composing them, as described on page 37, and mixing them in combination according to this system, cannot be emphasized too strongly to the student.

PRACTICAL HINTS.

The pigments used for illustrating this work are the purest obtainable, finely ground in water, bound with glue, applied and blended by hand on heavy, white, well sized paper. In order to obtain the most perfect results, it is necessary to keep palette, pots, brushes and everything entering into use for blending colors, perfectly clean. The necessary addition of glue for binding these color affects their purity but very little. The white pigment used for mixing the tints is the finest Cremnitz White. It is preferable to any other white pigment, be-

cause it can be applied more evenly, mixes readily and exerts but little or no chemical influence upon the other pigments.

Oil Colors. While the fundamental pigments ground in oil will produce darker tones, it would be impractical to attempt to make all combinations in this way. If any color should be desired darker it can be produced with the same pigments ground in oil.

COMMERCIAL MIXED COLORS.

If for practical purposes, quantities of mixed colors are required and the question of expense is to be considered, the desired color can be easily selected and defined by its fundamental colors; and if not too far from the point of balance, an inexpensive pigment similar in tone and hue may be substituted as a basis; and by comparison with the color selected it may easily be determined which primary or secondary color must be added to adjust it. It is plausible, however, that for reproducing purer color no substitute of lesser purity can be considered.

For example, if, by placing the perforated mat on Combination No. 2, Plate 1, Color No. 7 should be wanted in an inexpensive pigment, the common Venetian Red with a small addition of Chrome Yellow would answer the purpose.

IN PRACTICAL USE.

The merits of this system have been practically tested in the course of many years by the author, who has always worked on the pure color principle, which led to the development of this system. The possession of thousands of colors and tints, mixed under this system, and classified, enables the colorist to make the combinations, and by aid of the actual color samples furnished as a guide, to regulate their reproduction with the utmost precision.

There is no unknown or mysterious color in existence, therefore none can ever be discovered which could overthrow this system, however the colorist may hope for a continued progress in the manufacture of pure pigments to assist him in the heroic effort to rival with the luminosity and purity of the spectral colors to the very limitations which only nature itself will define.

THE END.

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